REMARKS

Applicant wishes to thank the Examiner for reviewing the present application.

The specification has been amended to conform with the scope of the amended claims. Applicant advises that no new subject matter has been added.

Claim 1 has also been amended to correct a typographical error.

In the Office Action, the Examiner has rejected claims 1, 4-12, 16-27 and 30-34 under 35 U.S.C. 103(a) as being obvious regarding Johnson et al. (US 5,113,357) in view of Raya et al. ("Shaped-Based Interpolation of Multidimensional Objects") and Liang et al. (US 6,606,091). Applicant respectfully traverses this rejection.

The present invention describes a system for extracting a visual feature from a volumetric dataset using an approximate volume. The system comprises a display for displaying the volumetric dataset; and an input device for defining a selected number of regions distributed in the displayed volumetric dataset, wherein each of the regions contains a cross section of the visual feature therein. The system also comprises an interpolator for generating the approximate volume containing the selected regions, the approximate volume comprising a set of voxels selected from the dataset. The system also has an operator for specifying the plurality of voxels not containing the visual feature in the set of voxels, to generate a mask; and a volume renderer for using the mask to render the volumetric dataset to extract the visual feature therefrom. The selected number of regions are a subset of the total number of images contained in the volumetric dataset.

Johnson et al. teaches a method and apparatus to directly render volumes from volume data whereby the resolution of the volume data is not lost and the volume data is completely interactive with geometric data. This is done by aligning a volume to be rendered to a geometric primitive defined by a reference frame and a mapping function is generated relating the

geometric primitive to the volume or volume portion. Geometric primitives are made up of lines, planes, triangles, spheres etc. and Johnson et al. performs geometric operations on the volume by performing the operation on the geometric primitive. In using geometric data, Johnson et al. teaches that the geometric data may be easily interacted with raw volume data because the raw volume data is being directly rendered in the geometry space.

Raya et al. teaches a shape-based interpolation method for multidimensional images, which consists of first segmenting the given image data into a binary image, converting the binary image back into a gray image wherein the gray value of a point represents its shortest distance from the cross-sectional boundary, and then interpolating the gray image. Raya et al. teaches a voxel-based (volume element based) method to interpolate a feature from slices containing sets of voxels. The teachings of Raya et al. therefore are directed to volume elements as opposed to geometric primitives.

Liang et al. teaches a method and system for extracting a 3D region of interest in a stack of scan slices by modifying several techniques to employ a variational interpolation technique to derive a 3D shape from these delineated 2D contours.

According to section 2143 of the Manual of Patent Examining Procedure (MPEP) in order to establish a *prima facie* case of obviousness three basic criteria must be met:

1. There must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one ordinarily skilled in the art to modify the reference or to combine reference teachings.
2. There must be a reasonable expectation of success.
3. The prior art reference(s) must teach or suggest all the claim limitations.

i) Is there motivation to combine the above references?

Firstly, the Examiner has primarily relied on the combination of Johnson et al. and Raya

et al. As mentioned above, Johnson et al. is directed to a rendering method involving the use of geometric primitives while Raya et al. is directed to a voxel-based shape interpolation method. Applicant believes that the teachings of Raya et al. and Johnson et al. are directed to dissimilar techniques for volume rendering and as such there exists no suggestion or motivation to combine these teachings.

As evidenced in col. 1, lines 21-44 of Johnson et al., there is a distinct difference in rendering images directly using volume data and fitting volume data to geometric primitives. Using geometric primitives involves the use of geometric data, as explained. Johnson et al. explains that in his opinion, the use of geometric data, unlike volume data may be easily rendered for display because the data provides the rendering information necessary to display a geometric image while volume data contains information related to the volume object itself.

Throughout the remainder of Johnson et al.'s explanation of the prior art, he explains in col. 1, line 63 to col. 2, line 3 that a voxel technique which creates a binary volume compressed for volume efficiency representing a surface boundary does not allow for semi-transparent or partial surfaces. As mentioned above, Raya et al. teaches segmenting image data into binary image. Therefore, while Johnson et al. describes what he believes is a drawback of using a binary image, which in fact is voxel based, it would be unrealistic to believe that a person skilled in the art would consider combining a geometric based method which teaches away from using a binary image with a voxel-based interpolation method which in fact does segment volume images into binary images.

The combination of Raya et al. and Johnson et al. is clearly counter-intuitive based at least on the motivations expressed in Johnson et al. and the fact that they describe entirely separate realms of volume rendering. Therefore it is believed that there would in fact be no motivation or suggestion therein to combine the teachings of Raya et al. and Johnson et al. and in fact, they teach in opposite directions.

The Examiner has additionally relied upon the teachings of Liang et al. to account for

claim limitations not found in the combination of Raya et al. and Johnson et al. As mentioned above, Liang et al. teaches an interpolation method which in part creates a mask of the image taken from slices of the 3D object. For reasons similar to those which would find it counter-intuitive to combine Johnson et al. and Raya et al., there would be no motivation to combine Liang et al. and Johnson et al.

Therefore, Applicant respectfully submits that the Examiner has erred in combining the above references for finding obviousness. The teachings of the references clearly provide no motivation or suggestion to combine the references. In fact the teachings of Johnson et al. would direct a person of skill in the art away from techniques such as those described by Raya et al. or Liang et al. Therefore it is believed that criterion 1 above has not been met.

ii) Is there a reasonable expectation of success?

As described above, while Raya et al. and Liang et al. teach using slices of the 3D object and a voxel approach to interpolation, Johnson et al. teaches away from this and towards the use of geometric primitives. Applicant believes that in making such a combination, the following drawbacks would be encountered:

a) The use of a voxel approach with Johnson et al. would be undesirable since Johnson et al. desires to retain as much volume data as possible.

b) The techniques employed by Raya et al. or Liang et al. would find the use of geometric primitives to be inefficient. For example, the ray in a ray tracing approach or moving planes in a multi-planar reprojection mentioned in Johnson et al. would need to be intersected with all the primitives for the volume definition as well as one for the clipping. In voxel based mapping, the flag of which voxels are visible is stored in the voxel and the voxel location can be accessed very efficiently.

c) The use of a voxel approach simply does not provide geometric primitives and

therefore would fail to achieve the objective set out by Johnson et al.

Accordingly, Applicant believes that in view of the foregoing, the combination suggested by the Examiner would not provide a reasonable expectation of success and hence criterion 2 above is believed to not have been met.

iii) Do the references teach all the claim elements?

Regarding claim 1, the Examiner has equated the slices shown in Figure 1 of Raya et al. to the functionality of the input device recited in claim 1. The input device in claim 1 operates to define a selected number of regions distributed in the displayed volumetric dataset. Each of the regions contains a cross section of the visual feature therein. Although Raya et al. shows in Figure 1, a group of slices which each contain a cross-section of a visual feature, Raya et al. does not teach defining a selected number of regions from a larger volumetric dataset.

Raya et al. merely shows in Figure 1, a set which contains the cross-sections used for his interpolation method. This cannot be assumed to represent a defined selected number of regions from a volumetric dataset. Figure 1 shows only a number of slices, each of which contains a cross-section of an object. Applicant believes that the Examiner has used 20/20 hindsight in reaching the conclusion that Figure 1 of Raya et al. teaches the functionality suitable for an input device as enumerated above. Furthermore, the defined set of regions are chosen for the purpose of extracting a visual feature from a volumetric dataset. Raya et al. does not teach or suggest this. The slices in Figure 1 show cross-sections of a single object and the interpolation method is applied to the single feature in an attempt to provide a real-time depiction of the movements of that feature. (see page 33, col 1, second to last paragraph). Therefore Figure 1 does not depict the extraction of a feature but the interpolation of an object between instances of time.

Accordingly, the slices shown in Figure 1 are not defined from a set of slices nor is there suggestion that this is the case. Likewise, the slices are not chosen for extracting a visual feature from a volumetric dataset. As such, for at least these reasons, it is believed that the combination

of prior art does not teach the input device recited in claim 1 and therefore criterion 3 is believed to not have been met by such a combination.

In view of the foregoing, Applicant believes that the combination of prior art suggested by the Examiner does not meet any of the above-outlined criteria for establishing a *prima facie* case of obviousness. Particularly, there exists no motivation or reasonable expectation of success to combine two invariably dissimilar volume rendering techniques and the teachings of the prior art in fact teach of this dissimilarity, and it appears the Examiner has improperly equated what is shown in Figure 1 of Raya et al. to the functionality of the input device for defining a set of regions from the larger volumetric data set recited in claim 1.

Accordingly, the Applicant believes that claim 1 clearly and patentably distinguishes over the combination of prior art suggested by the Examiner and is in condition for allowance. Claims 4-18 are either directly or indirectly dependent on claim 1 and therefore are also believed to distinguish over the prior art.

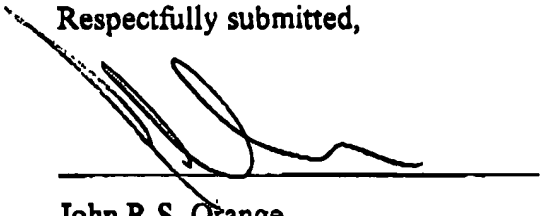
The Examiner has used similar arguments for claim 19 as for claim 1. Claim 19 is directed to a method suitable for use with the system recited in claim 1 and therefore similar arguments used in favour of claim 1 apply to claim 19. As such, claim 19 is believed to distinguish over the combination of prior art suggested by the Examiner. Claims 20-32 are either directly or indirectly dependent on claim 19 and as such are also believed to distinguish over the prior art.

The article of manufacture recited in claim 33 also relates to the system and method of claims 1 and 19 respectively. Therefore similar arguments apply and as such claim 33 is believed to distinguish over the prior art. Claim 34 is dependent on claim 33 and as such is also believed to distinguish over the prior art.

In summary, Applicant believes that claims 1, and 4-34 clearly and patentably distinguish over the combination of prior art suggested by the Examiner and as such are in condition for allowance.

Applicant requests early reconsideration and allowance of the present application.

Respectfully submitted,



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Date February 4, 2005

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